BRIDGE DESIGN FOR MACAIBAN BRIDGE IN SANTA MARIA, BULACAN. ENHANCHING FLOOD RESILIENCE AND COMMUNITY SAFETY

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Major in Construction Engineering and Management

by

CAPARAS, GRETZELL JADE L.

CRISPO, DERYCK RUSSEL J.

OTTO, MARY ANN S.

CAY, LEO

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RECOMMENDATION

This is to certify that this research entitled "BRIDGE DESIGN FOR MACAIBAN BRIDGE IN SANTA MARIA, BULACAN. ENHANCING FLOOD RESILIENCE AND COMMUNITY SAFETY" prepared and submitted by Gretzell Jade L. Caparas, Leo Cay, Deryck Russel J. Crispo and Mary Ann S. Otto have been examined and PASSED the PRE-ORAL DEFENSE

ENGR. ELOISA P. CADAG, Reg. CE.., MACT

Research Adviser

PANEL OF EXAMINERS

Examined and approved by the Panel of Examiners in Pre-Oral Defense with a grade of _____ on November _____, 2025, at La Concepcion College, Bulacan

Engr. CAROLINE A. ASUNCION, MPA

Chairperson

Engr. CAMILO A. BATULAN JR., MSCM

Member

Engr. DANILO A. CASAS, LPT, MAed

Member

Accepted as partial fulfillment of the requirements for the Degree of Bachelor of Science in Civil Engineering.

Engr. JORE GIL D. GALEZA, MEM, Ph.D.(c)

Division Head of Civil Engineering

DR. LEILANI I. CUSACK., Phd, DBA

Dean of Instruction

CERIFICATE OF ORIGINALITY

This is to certify that this research paper was originally made by the researchers and does not contain any material previously published or written by the another person nor material to substantial extent of being accepted for an award or any degree of diploma n La Concepcion College and the other educational institutions except where due acknowledgement is made in the research paper.

We also declare that the intellectual content of this research is a product of our own effort, conceptualization and brainstorming in aiming to improve certain problem of our society. Any contribution made to the research of other is explicitly acknowledged in this paper.

Deryck Russel J. Crispo

Gretzell Jade L. Caparas

Leo Cay

Mary Ann S. Otto

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CHAPTER 1

THE PROBLEM AND ITS BACKGROUND

Introduction

In the Philippines, the needs of an infrastructure that performs all kinds of activities related to the improvement, economical growth, and service of the nation is one the most important thing the government is trying to focus on. Transportation system is one of the crucial infrastructure a nation must have due its vital role in economic development of the country because it connects two destinations, which creates a link for social and economic activities. Throughout the Philippines, bridges play a crucial role in connecting communities and improving transportation networks. These bridges not only provide a means of crossing rivers, valleys, or bodies of water, but they also promote economic development, social connectivity, and overall well-being of the population in a certain place. However, in some parts of the Philippines, bridges are often flooded and cannot be used by vehicles and pedestrians to cross the other side even in a moderate rainfall. This kind of overflowing not only affects the structural stability of the bridge, but also creates a traffic congestion on the area, have a significant negative economic effects, including direct costs for repairs, indirect costs from business and supply chain disruptions, and long-term impacts like reduced investment and slower economic growth.

The Macaiban Bridge in Santa Maria, Bulacan is one the bridge that is often experiencing this kind of problem when light to intense rainfall struck. This bridge is an important not only for the locals but also in the whole population of Bulacan, because this bridge is a connection of two barangay that makes it easier for locals to access goods. Despite the importance of the bridge is, repeated flooding and debris buildups made it inoperable during heavy rains or even light rains over the years. These concerns not only make the safety of locals and commuters at risk but also affects the emergency response and local businesses. Previous reports noted that the flooding often submerge the Macaiban Bridge during light or severe storms, making it unsafe for vehicles and pedestrians. While flooding may happen due to multiple factors such as sediments accumulation,debris build-up around piers and inadequate height of approaches, local engineering studies and research by students have provided evidence that the bridge is poorly sized to respond to structural environment.

Interestingly, the Department of Public Works and Highways (DPWH) has already identified the overflow troubles in the area and included the Macaiban Bridge in its construction and rehabilitation works, clearly indicating a long-term demand for an engineering solution. So far, none of those actions and assessments resolve the flooding issue, and redesign is needed. A redesigned Macaiban Bridge must improve the performance on the bridge, with higher vertical and horizontal clearances

that can accommodate higher water levels and stronger flows and maintain structural integrity under debris impact. And it has to provide easier access for the locals residing in Santa Maria Bulacan. The purpose of this study is suggest a redesigned Macaiban Bridge in Santa Maria, Bulacan.

The study will provide recommendations on appropriate design efforts by examining detailed findings from previous research, and site specific studies to examine the structural context of the previous design, aiming to a design that prioritize safety, resiliency, and accessibility for the locals. In short, the redesigned Macaiban Bridge expected to serves as a sustainable and resilient piece of structure to withstand continues flooding issues while encouraging ongoing growth and connectivity in Santa Maria and beyond.

Background of the Study

The Macaiban Bridge serve as alternate route to the community. This bridge connects two baranggays which are Poblacion and Tumana. It gave the commuters an advantage in terms of saving time and money by taking this bridge instead of the national road, which is often compromised by the traffic. The main problem of this study is that this bridge cannot serve its own purpose when it overflows. Some motorists no longer tried to pass the Macaiban Bridge after the river overflowed and covered the structure, making it unusable due to heavy rain and even moderate rain. The bridge is not

passable when it's flooded to prevent possible accidents or drowning by anyone who insists on crossing Researchers, specifically for civil engineering students from the Polytechnic University of the Philippines,analyzed flood issues at the Macaiban Bridge and conducted a cost-benefit analysis for different mitigation strategies to propose the most economical and feasible solutions for the problem. Their research included conducting surveys with residents, using hydrologic and hydraulic modeling software, and performing a cost analysis of potential development scenarios to improve river conditions and bridge access.

Many studies focus on immediate causes rather than the systemic and complex interdependencies leading to bridge failure. Researchers may have inherent biases in their choice of methodologies or data collection, leading to incomplete or skewed conclusions. A lack of collaboration between different disciplines (e.g., civil engineering, environmental science, and social sciences) can hinder a holistic understanding of bridge performance and failure.As student researchers, we conduct a survey questionnaire to obtain the preliminary information to start the research process. This initial information is required to have an insight into the perspective of the main affected citizens regarding the development of the river and to determine what factors are to be given importance through the research process.

Theoretical Framework

The re-design recommendations of the Macaiban Bridge in Sta. Maria, Bulacan is based on a number of structural, and environmental theories that provides sustainable structure. Bridges must be constructed based on guidelines to ensure safety, and the resilience to withstand natural hazards as well as human made.

Structural Reliability Theory - by Michael J. Baker. Other influential authors in the field include R. E. Melchers, whose work includes Structural Reliability Theory in the Context of Structural Safety, and others like I. Elishakoff, G. Augusti, A. Baratta, and F. Casciati.

Sustainable Infrastructure and Resilience Theory - Theory contributed concepts include C.S. Holling for the concept of resilience, and authors of recent articles such as Moses Alabi, Nur Shuhada Nor Shahrudin.

This structural reliability theory provides the foundation for assessing the safety and performance of bridges under different conditions, which the probability of structural failure of the structure to decreases when the proper design and parameters such as material strength, load distributions are applied. So, when redesigning Macaiban Bridge, they need to think about reliability-based methods to lower the chances of it falling down or having problems with its service.

Sustainable Infrastructure and Resilience focuses on being long-lasting, environmental friendly, and able to withstand to the continues changes in weather conditions. The resilience theory shows how structures can survive and natural disasters like typhoons and floods. Using these theory makes sure that the newly built bridge will not only fix the issues, but it will also be able to handle the water current during intense rainfall.

The researchers uses these theoretical frameworks to be the guide in redesigning Macaiban Bridge to meet the structural deficiencies, to reduce flooding issues, and promote sustainable development in Sta. Bulacan, Maria.

Conceptual Framework

INPUT	PROCESS	OUTPUT
1. HYDROLOGICAL AND ENVIRONMENTAL FACTORS a. Frequency and intensity of flooding b. Geological structure river flow characteristic **2. STRUCTURAL AND DESIGN CONSIDERATION** a. Durability and maintenance	**1. Redesigning the bridge by AutoCAD techniques to improve the use of structure** **2. Conducting a survey to gain some information to be useful for innovation ideas** **3. Evaluating the design of the structure and observe the site thoroughly**	**A.** Detailed hydrologic and hydraulic analysis report to determine the required bridge opening, waterway clearance, and optimal pier placement. B. Comprehensive site and structural assessment detailing soil bearing capacity, existing foundation stability, and environmental constraints. C. Identified flood-resilient design criteria for Macaiban Bridge, specifically focusing on enhanced resistance to scour and high flow. A. Finalized and validated bridge design plans and

requirements b. Innovative materials c. Cost of materials		specifications (using AutoCAD/similar software) that optimize structural integrity and minimize maintenance costs while meeting safety and flood resilience standards. B. Recommended innovative, durable, and cost-effective material selection suitable for the local environment and climate conditions. C. Complete project cost estimation and bill of materials (BOM) for the enhanced bridge design.

Statement of the Problem

The Macaiban Bridge serves as an easier access for residents, commuters, and local businesses if the main road is compromised by the traffic. However, the said structure has long been reported to experiencing safety issues due to some circumstances such as frequent flooding, structural deterioration, traffic congestion, and insufficient load capacity. Which compromised it's safety and functionality. These problems not only paralyzed the mobility but also endangers some life and hinders economic activities within the area.

The researchers seeks to address the following problems:

1. How does the demographic profile of the respondents be gauged in terms of:

1.1 Age

1.2 Gender

1.3 Length of residency

2. How can the current structural problems of Macaiban Bridge be assessed in terms of:

2.1 Accessibility

2.2 Safety

2.3 Structural Condition and use

3. How effective does the current bridge design address the limitations of the structure in terms of:

3.1 Load capacity

3.2 Accessibility

3.3 Sustainability

4. How can the design of Macaiban Bridge be assessed in terms of:

4.1 Structural stability

4.2 Cost-effectiveness

4.3 Long-term use

By answering these given questions, the study will focuses to provide a sustainable re-design plan for the bridge that ensure the safety and efficiency of the Macaiban Bridge for the community that will use it.

Objectives of the Study

This study aims to design a new bridge in Macaiban Bridge in Santa Maria, Bulacan to avoid the river overflow from making it passable, which had been a cited issue with the original structure.

1. To determine the demographic profile of the respondents in terms of:

1.1 Age

1.2 Gender

1.3 Length of residency

2. To assess the current structural condition of the Macaiban Bridge in terms of:

2.1 Accessibility

2.2 Safety

2.3 Structural Condition and use

3. To examine the effectiveness and limitations of the current bridge design in terms of:

3.1 Load capacity

3.2 Durability

3.3 Flood resilience

4. To investigate the efficacy of the proposed innovative bridge design for Macaiban Bridge in terms of:

4.1 Structural performance

4.2 Flood mitigation capability

4.3 Community safety improvement

Hypothesis

- **(Ho)** There is no significant difference in the flood mitigation efforts and the frequency or severity of flooding at the Macaiban Bridge in Santa Maria, Bulacan.

- **(Ha)** There is a significant difference in the flood mitigation efforts and the frequency or severity of flooding at the Macaiban Bridge, meaning that the new bridge design will be effective.

Significance of the Study

This research will provide the improvement of a structure in Macaiban Bridge, Sta. Maria. The design is to make the structure more resilient and sustainable in various factors like hydrological and environmental factors. This study benefits the local community by innovating the Macaiban Bridge. It also gains more knowledge in the field of engineering by introducing the application of innovative and sustainable design principles.

Scope and Limitations of the Study

It includes hydrological and environmental considerations and structural, material, and community safety aspects. This study points out the

advanced engineering techniques, such as structural design and innovative construction materials. The objective of this research is to understand the alternative way to improve the infrastructure of the bridge.

The actual construction, cost implementation, and long-term maintenance undertakings fall beyond this study's focus. The data concerning the hydrological and geotechnical conditions will be based on the secondary sources and field observation, which might not be adequate to analyze the extreme floods. Moreover, while the project design proposal targets community safety and resilience, no detailed socioeconomic study or full-scale future climate variability simulation was conducted.

Definition of Terms

In order to clarity and avoid ambiguity to the readers, the following key terms are defined conceptually from authoritative sources and operationally that are being applied in this study.

Climate variability refers to natural, short-term fluctuations in climate conditions—such as temperature or rainfall

Cost Implementation refers to the maximum flow rate of fluid a system can handle or the maximum force a hydraulic cylinder can generate, depending on the context.

Flood resilience - is a term that has become more commonly used, and generally means that damages are minimized during times of flooding resulting in less risk to people and infrastructure and ensuring that there is ample room for flooding and river adjustment to occur where the opportunity may exist.

Geological Structure - refer to the arrangements and relationships of rock layers and features, such as bedding planes and faults, which influence rock fracture depending on conditions like their openness, confinement, nearby free surfaces, and spatial orientation.

Hydraulic Capacity refers to the maximum flow rate of fluid a system can handle or the maximum force a hydraulic cylinder can generate, depending on the context.

Hydrologic - relating to or dealing with water on Earth, including its distribution, movement, and properties on and below the surface and in the atmosphere.

Interdependencies occur when two or more entities—whether individuals, organizations, or systems—rely on each other to function or thrive

Long-term maintenance refers to the ongoing process of planned actions, inspections, and repairs to preserve the condition, functionality, and value of assets over an extended period.

Methodologies a system of methods used in a particular area of study or activity.

Resilience is the ability to adapt, cope, and bounce back from adversity, stress, or trauma while maintaining psychological well-being

Traffic congestion - defined as the overcrowding of roads and streets that negatively impacts living standards in metropolitan areas, often exacerbated by the high use of personal vehicles and insufficient infrastructure.

Traffic flow - is the study of interactions between travellers and infrastructure, with the aim of understanding and developing an optimal transport network with efficient movement of traffic and minimal traffic congestion problems.

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CHAPTER 2

REVIEW OF THE RELATED LITERATURE AND STUDIES

This chapter presents related studies and literature from variety articles and website that are related to the study. These data serves as the researchers' preliminary steps and point of reference to fully understand the research for better comprehension of the study.

Foreign Literature

David Yeomans' book "How structures work: design and behaviour from bridges to buildings" is conducted by John Wiley & Sons (2025). When designing a building, structural engineering is crucial. how the structure responds to different types of force. Without using intricate mathematics, it provides a clear explanation of how structures behave. It is to guarantee the completeness and durability of the buildings and structures surrounding us. It is intended for everyone who needs a deeper comprehension of behavior, design, and structures.

According to Jan Bień and Marek Salamak (2022). Bridge structures may be subject to Increased volumes of traffic, higher loads, and more severe. It is subjected to different environmental conditions than intended.

This paper addresses the main challenges. Emerging possibilities in bridge structural management, including: connection between environment and bridge infrastructure, improved bridge modeling in computer - based management systems, applications of Bridge Information Modelling (BrIM) technology with augmented and virtual reality technologies. The history of developing Bridge Management Systems is presented in the suggested classification. And highlights the anticipated paths for their growth, accounting for evolving obstacles and implementing emerging technology with new developing technologies.

Local Literature

The Department of Public Works and Highways (DPWH) show the major standards, manuals, and stock that manage the bridge planning, design, and maintenance in the Philippines. These national reference designs high point the site - specific evaluation, uniform load, geometric specifications, and the necessity of building resilience measures into transport infrastructure planning.

Adarne and Henry (2024 consoli date regional effects on Philippine road bridges andadvocate for designing bridges not only to withstand loads but also to connectivity (functional resilience) using adaptive structural elements, enhanced foundation solutions, and ranked network redundancy. These results underscore the significance of design decisions (foundations,

approach protection, and scour countermeasures) that directly mitigate seasonally recurring flood forces at rural bridges such as Macaiban.

Local research on household / community and flood vulnerability drivers indicates that structural repairs alone are not enough: social vulnerability, land use, and community preparation heavily influence the way floods convert into loss. A Philippines - centric study of social drivers of flood risk shows how patterns of settlement, economic marginalization, and low take - up of early warnings amplify damage even wethere are Infrastructure interventions. These social - technical lesson contend that Macaiban Bridge design should include evacuation access, accessible signage / path, and local community - based maintenance plans to enhance community safety.

Pilot works and applied design research in Philippine provinces and cities give examples on how to merge engineering innovation with local governance. Co-design practice for Davao City and other urban pilots illustrates the ways in which iterative planning and stakeholder workshops generate locally adapted flood - resilience strategies (elevated crossing, enhanced drainage incorporation, and green - infrastructure buffers) while gaining better community acceptance. Barangay - level bridge project case studies illustrate functional innovations applied to the Philippine setting — reduced foundations for soft ground conditions, raised approach to restrict overtopping, and affordable scour protection — lessons that can be applied

directly to Macaiban's local conditions and budget constraints.

Foreign Study

Research conducted by the U.S. The Federal Highway Administration (FHWA, 2021) came up with a framework for incorporating a failure of bridge design to enhance resilience against natural hazards, such as floods. It emphasizes the need for performance that assesses the multiple failure modes, such as pier scour and foundation instability. Resilient bridges should include redundancy and energy dissipation capacity. The Macaiban Bridge suggests the adoption of a performance design approach to ensure that the structure is serviceable even after flooding events.

The study combined literature, design advice, and interviews with engineers from Europe and the U.S. Wheeler et al. (2022) looked at how nature - based solutions (NBS), such as vegetated riverbanks, reconnecting floodplains, and constructed wetlands, can work with traditional infrastructure like levees and bridges. Using NBS in bridge design can reduce flood peaks, stabilize riverbanks, and increase biodiversity. For the Macaiban Bridge, hybrid designs that incorporate riverbank protection or Retention ponds can mitigate flooding and support ecological balance.

The study by Okamura and Deschamps (2020) was a comparison of scour risk guidelines applied in Japan and France. They examine how varying safety factors and monitoring standards influence bridge foundation performance during floods. Japan places greater emphasis on regular monitoring and conservative design estimates under different flow conditions. Applying these approaches to Macaiban Bridge would improve long - term flood safety, especially in areas with unstable soil and high sediment transport.

Local Study

This research study by David Nepomuceno (2023) entitled "Technology Innovation for Improving Bridge Management" focuses on improving data collection, enhance inspector safety, and reduce the number of potential road closures which can help to this research regarding the issue of Macaiban Bridge in Sta. Maria. For this study, numerous research efforts have been particilted with the goal of automating significant portions (or the entire) of the inspection process.

The technologies were adapted for various challenges impeding consistent innovation and widespread adoption in the Industry. This experiment study was capable for representing the data generated. The inspectores solely used digital to defects that has received little attention. The result for this study was to improve the inspection through remote - controlled to lessen the prone in hazard and to focus the developing

framework in on - site operation. It is viewed by the author that adapting implement newer technologies can be make thing easier.

Synthesis of Review of Related Literature and Studies

The research and literature reviewed emphasize how crucial it is to combine local context, technology, and structural design in building resilient bridges. In order to increase durability and flood resistance, foreign sources place a strong emphasis on structural behavior, the application of contemporary technologies like Bridge Information Modeling (BrIM), and nature - based solutions.

In contrast, local literature concentrates on modifying bridge designs to fit the Philippine context by taking environmental risks, socioeconomic vulnerability, and environmental dangers into account.The importance of new technology in maintenance and inspection is also emphasized by studies. These insights support the development of a more resilient and sustainable design for the Macaiban Bridge in Sta. Maria.

CHAPTER 3

RESEARCH METHODOLOGY

The study employed a research methodology to evaluate the Macaiban bridge in Sta. Maria, Philippines. It includes research design, sample technique, research instrument and data analysis.

Research Design

The researchers utilized a quantitative research approach with a descriptive research research design to gather enough information that is needed to assess or identify the reason in overflowing problem of the Macaiban Bridge in Sta. Maria, Bulacan. The researchers will focus on collecting numerical information using field measurements, surveys, and simulations to have enough knowledge what kind of bridge re-design will be proposed that can reduce the overflowing on the bridge. The gathered information and data by the researchers will be investigated to ensure if the proposed re-design will improves the bridge's performance and minimizes flood compared to the existing structure.

Sample and Population

To gather quantitative data from individuals and groups directly affected by the design of the Macaiban Bridge in Santa Maria, this research employed a purposive sampling method. This approach was selected as it allowed the researchers to identify respondents possessing relevant information, experience, or association with the bridge design. This study serve as information

to the researchers to identify the data that needed to implement the necessary solution for designing bridge. The target population for this study, were comprising local inhabitants like commuters and households affected by flooding, civil engineers, environmental specialists, public health experts, and government officials, all of whom are connected directly or indirectly to the bridge's design and effects.

Research Instrument

A structured survey questionnaire was the main research instrument employed in this investigation. It has been designed particularly to accumulate quantitative data from the residents, the commuters, and the professionals related to the Macaiban Bridge in Sta. Maria, Bulacan. The questionnaire includes both closed-ended and rating-scale items with the intention to gauge the respondents' observations and experiences about the bridge's condition, the frequency of flooding, the flow of traffic, and overall safety. Thus, this instrument guarantees the consistency and the objectivity of the collection of measurable data, which can further be analyzed statistically to find out the major factors that contribute to the bridge's performance issues and the community's needs for improvement.

Alongside the questionnaire, visits to particular key informants (like civil engineers, environmental specialists, and local government officials) were also made to confirm the main data and add expert opinions. By including these interviews, the discussions strengthen the authenticity of the results and push professional opinions on the bridge's current limitations and potential redesign

solutions. Both research instruments were created and approved by the researchers so as to ensure and provide the legitimacy ofclarity, relevance, and reliability before the actual data collection.

Data Analysis Method

The gathered data by the researchers from the locals residing near the Macaiban Bridge by using survey questionnaires and interviews will the interpreted and analyzed using statistical methods and techniques to identify the effectivity of the proposed re-design of the Macaiban Bridge. In addition, the acquired information from the locals through survey questionnaires and interviews will be computed, interpreted and tabulated using statistical methods such as the frequency, percentage, mean, and standard deviation. In this methods, the researchers will be able to identify the level of flooding problem, bridge performance and community satisfaction. The outcome will then be evaluated by the researchers for them to draw a conclusions and suggest a recommendations on what will be the best design will suit to resolved the overflowing issues of the Macaiban Bridge.

Statistical Tool

The information collected via survey questionnaires was through descriptive statistical methods to interpret and summarize the participants' answers. The researchers took up frequency and percentage as measures to

identify the spread of the responses with regard to the observed flooding incidents, the structural conditions, and the safety concerns in the case of the Macaiban Bridge. The following formula was applied to calculate the percentage:

$$\text{Percentage } (\%) = \frac{f}{N} \times 100$$

where:
f = frequency of responses
N = total number of respondents

In order to gauge the general opinion of the respondents regarding the bridge's performance and safety, the weighted mean was calculated through the application of the following formula:

$$\text{Weighted Mean (WM)} = \frac{\sum fx}{N}$$

where:
f = frequency of each response
x = weight or rating of each response
N = total number of responses

The standard deviation (SD) was also computed to see the dispersion of the responses and the following formula was used:

$$SD = \sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}}$$

where:

x = individual score

$\bar{x}$ = mean of all scores

N = number of responses

Besides the statistical methods, basic engineering equations were also applied to the assessment of the bridge's structural capacity and performance. The bending stress (σ) in the beams was calculated by:

$$\sigma = \frac{Mc}{I}$$

where:
σ = bending stress (MPa)
M = bending moment (N·m)
c = distance from the neutral axis to the outermost fiber (m)
I = moment of inertia (m^4)

The bridge components' load capacity (P) was also found out using this equation:

$$P = \frac{f_y A}{FS}$$

where:

P = allowable load or capacity (N)

fy = yield strength of the material (MPa)

A = cross-sectional area (m^2)

FS = factor of safety

All these statistical and engineering calculations gave a precise numerical result and technical support to the researchers. The analysis also allowed the researchers to take the bridge's condition as a whole, pinpoint the weak spots, and come up with a viable and eco-friendly re-design proposal for the Macaiban Bridge.

Good Day!

We the Bachelor of Science in Civil Engineering Students, major in Construction and Management from **La Concepcion College, Inc.** are currently conducting a research titled **"Bridge Design for Macaiban Bridge in Santa Maria, Bulacan. Enhancing Flood Resilience and Community Safety."**

The purpose of this study is to gather information about your experiences and opinions on bridge flooding in your area. The data gathered from this survey will serve as an important basis in designing a more efficient and sustainable bridge.

All responses will be kept **confidential** and used **only for academic purposes**.
We truly appreciate your time and honest participation.
Sincerely,
The Researchers

SURVEY QUESTION

Please follow these instructions:

Read each question carefully. Take your time to understand what is being asked before selecting your answer. **Answer all questions honestly.** Your responses will remain confidential and will be used only for research purposes. Put a check mark (✓) in the box that represents your answer.

PART I. RESPONDENT DEMOGRAPHIC PROFILE

1. Name (Optional):_____

2. Age : _____

3. Gender : ☐ Male ☐ Female

4. Length of residency in this community

☐ Less than 1 year ☐ Less than 5 years ☐ Less than 10 years ☐ More than 10 years

PART II. ACCESSIBILITY, SAFETY STRUCTURAL CONDITION AND USE

Instruction: Put a check mark (✓) in the box that represents your answer.

5 - Highly Satisfied 4 - Satisfied 3 - Neutral 2 - Dissatisfied

1 - Highly Dissatisfied

ACCESSIBILITY

Evaluating the ease of passage under normal conditions and its capacity to handle traffic volume.

Assesement	5	4	3	2	1
1. How would you rate the ease of crossing the bridge during normal weather conditions (no flooding)?					
2. How would you rate the visibility of the bridge at night (e.g., street lighting)?					
3. How would you rate the bridge's overall ability to handle the current volume of traffic (cars, tricycles, etc.) without excessive congestion?					

SAFETY

This assessment focuses on your personal sense of security while using the bridge.

Assesement	5	4	3	2	1
1. How would you rate your sense of safety when driving or walking across the bridge?					
2. How would you rate the condition of the side railings/barriers meant to protect vehicles					

and pedestrians?					
3. How would you rate the bridge's ability to withstand strong water currents and flood events based on past experience?					

STRUCTURAL CONDITION AND USE

The final section measures the bridge's practical effect on your travel.

Assesement	**5**	**4**	**3**	**2**	**1**
1. How would you rate the bridge's importance in connecting you to essential services (e.g, school, market, hospital)?					
2. How often are you prevented from using the bridge due to flooding or high water levels?					
3. How would you rate the smoothness and speed of your daily travel (commute) compared to having no bridge or a difficult bridge to cross					